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Besides the principal characteristic mentioned above, the observations of their radial velocities show that their orbits are similar in that they have eccentricities of two- or three-tenths and similar ranges of velocity, that is, amplitudes of more or less thirty kilometers. These properties are also important characteristics of the *Cepheid* binary-variables.

G. F. Paddock.

Probable Errors in Meridian Circle Observations.

(Abstract)

The comparison of fourteen hundred readings of both circles, in the fundamental work of the years 1905 and 1906, gives the probable error of a difference of the two simultaneous circle readings, ± 0″.35. The settings on seventy-seven dates, with an average of eighteen each date, are included. The movable circle was shifted about one degree after each date. The errors include the effect of division errors of both circles, but the bisection error upon star or nadir would be the same for both circles, and does not enter this result.

The distribution of the errors has been tested by the count of the residuals, which checks the final result, and the agreement of observation with theory.

COUNT OF RESIDUALS.

Under 0″.35 = p. e.	Count	727	Theory	701
0″.35 to 0″.70 = 1 to 2 times p. e.	“	441	“	453
0.71 to 1.05 = 2 to 3 “ “	“	169	“	188
1.06 to 1.40 = 3 to 4 “ “	“	48	“	50
1.41 to 1.76 = 4 to 5 “ “	“	15	“	9
Over 5 times p. e. [5.5 and 5.7]	“	2	“	1
Sum	“	1402	“	1402

The residuals of largest size are slightly in excess of theory, which is a common result of experience in handling the results of probable error discussions, and is due to the accumulation of all the unfavorable conditions in some few instances.

The graduations are alike on both circles, and subject to the same class of errors, and the above error can be distributed, ± 0″.25 for either circle. The probable error of graduation is ± 0″.19 for the mean of four divisions, as derived in the final measures of graduation errors, and confirmed quite precisely by recent observations of a list of six hundred stars in both positions of the instrument, fixed circle east and fixed circle west. There remains ± 0″.16 for the probable error of a circle reading under four microscopes, which is confirmed by the discussions of much old and recent work.

In comparing the readings on the two circles the prevalence of small progressive changes, due probably to the shift in positions of one or more of the eight microscopes, is plainly evident. The change is ordinarily checked by the readings on the nadir, but this comparison throws into relief many small changes that might be overlooked in the discussion of the readings of one circle only. In about two-thirds of the number of series, changes of 0″.1 per hour in the combined readings are evident. In one-third, there are changes of 0″.3 per hour. Ten per cent show changes of 0″.5, or over, and the largest change is a full second of arc per hour. The effect of such changes can be fully eliminated in the reduction of the observations, provided they are progressive, which, as a rule, is indicated in the comparison.

The results of the observations of the stars discussed for the diurnal change of refraction, in this same series, have been tested with these values of the probable errors. The probable error of a difference of zenith distance, from the two circles, based upon the comparison with a pair of zenith stars, was ± 0.″42. This would be distributed, ± 0″.25 for a refraction star, and ± 0″.18 for the pair of zenith stars, or ± 0″.31 for each circle. Similarly, by comparing with the nadir, the probable error would be ± 0″.48, which would be distributed, ± 0″.25 each for the star and nadir, or ± 0″.35 for each circle.

The resulting bisection errors are derived by deducting these errors from the total probable error of an observation. Dividing the results of forty observations of each of three refraction stars into groups of day observations, and night observations, of about equal numbers, the resulting probable errors of a bisection on a star are ± 0.″11 at night, and ± 0.″32 by day. Deducting these bisection errors from the probable errors of the observed values of the latitude φ, there remain the probable errors of a bisection on the nadir, ± 0.″17 at night, and ± 0.″32 by day. These are of a similar order to the errors of bisection on a star, and more precise at night, when the conditions of observation are generally much more favorable.

The bisection errors on a star must include any vagaries of the atmospheric refraction, such as have been suspected by other observers in their treatment of differential measures. Meridian circle results here do not confirm the existence of abnormal changes in the effect of refraction, of any sensible amount, or of more than transitory character, such as may appear in the unsteadiness of the star images under bad conditions.

As a further illustration of the distribution of accidental errors, the count of the residuals from the probable error discussion of the observations of 1914, upon some six hundred faint stars, is tabulated below, in combination with the preceding count. There were twelve hundred residuals in each coordinate, in the comparison of single observations in one position of the instrument, and six hundred in each coordinate, in the comparison of the results in the two positions. The total number of residuals counted is above five thousand. Each group had been treated separately, but the counts are so nearly similar that one tabulation will exhibit the general agreement of observation with theory.

COUNT OF TOTAL NUMBER OF RESIDUALS.

1 p. e.	Count 2522	Theory 2507
1 to 2 times p. e.	" 1593	" 1617
2 to 3 " "	" 676	" 676
3 to 4 " "	" 172	" 180
4 to 5 " "	" 43	" 31
Over 5 " "	" 6	" 3

The larger errors are slightly in excess of the theoretical distribution. The first group, which may be said to define the term "probable error," is less than one per cent in excess of theory.

R. H. Tucker.

On the Radial Velocities of the Orion Nebula. (Abstract)

The question of differential motions within the bright-line nebulae has been considered by several astronomers. Keeler's instrumental equipment and methods made the first close approach to detecting such motions, in 1890-91, as Doppler-Fizeau effects. He observed the spectrum of the inner and brighter parts of the *Orion* nebula, chiefly the region preceding the Trapezium, for local broadenings or distortions of the spectrum lines, with negative results. He estimated that differential velocities as great as 8 km./sec. in the brighter parts of the nebular structure would have been detected. It should be said that the results of the last three years, described below, have shown that the variations in the region observed by Keeler do not exceed 8 km./sec.

In 1902 Vogel and Eberhard found evidence of differential velocities in the Orion nebula. Their observed radial velocities